

Energy Escalation Rate Calculator (EERC) User Guide

Summary

EERC computes an average rate of escalation for a specified time period, which can be used as an escalation rate for contract payments in ESPCs and UESCs. While the underlying energy price projections vary from year to year, for calculating contract payments the EERC-calculated uniform average rate is preferable. The rate is stated in real (excluding inflation) and nominal (including inflation) terms and weighted by the share of each of the energy types used in the project. When applied to the base-year energy costs or savings of ESPC or UESC projects, it results in approximately the same total amounts over the performance period as do the underlying energy price projections. To assist federal agencies in considering a range of energy price scenarios, escalation rates may be computed based on: (1) the annual energy price forecasts of the EIA, which do not account for potential carbon pricing, and (2) EIA projections adjusted by NIST for three levels of potential carbon pricing. This range of rates may be considered by federal agencies for use as energy price escalation rates for contract payments, when the payments are based on projected annual energy cost savings.

The EIA projections adjusted by NIST for potential carbon pricing are based on three carbon policy scenarios. Default Pricing stems from a carbon policy scenario which does not restrict the type of capacity that electric utilities may install to meet carbon emissions targets. The default scenario assumes that all countries, including developing countries, will begin to restrict carbon emissions over the next 40 years. Low Pricing assumes that developing countries do not take any action over the next 40 years to restrict carbon emissions, which decreases the demand for carbon reductions and allows polluters in the U.S. to purchase carbon offsets from other countries at a lower cost. High Pricing assumes that carbon offsets are not allowed, and nuclear and biomass capacity construction is restricted. Both assumptions limit some of the least expensive options available to decrease carbon emissions, causing carbon prices to increase.

The prior (executable) user interface is shown below. The user provides the fuel type, fuel rate, study period, carbon pricing scenario, and inflation rate. Default values are provided for carbon pricing scenario (no carbon price) and inflation rate (based on annual supplement value). The discount rate is fixed based on the Annual Supplement. The output is a real escalation rate and nominal escalation rate values.

Percent of Energy Cost Savings	
Fuel Type	Weight (%)
Coal	0
Distillate Oil	0
Electricity	0
Natural Gas	0
Residual	0
Total	0

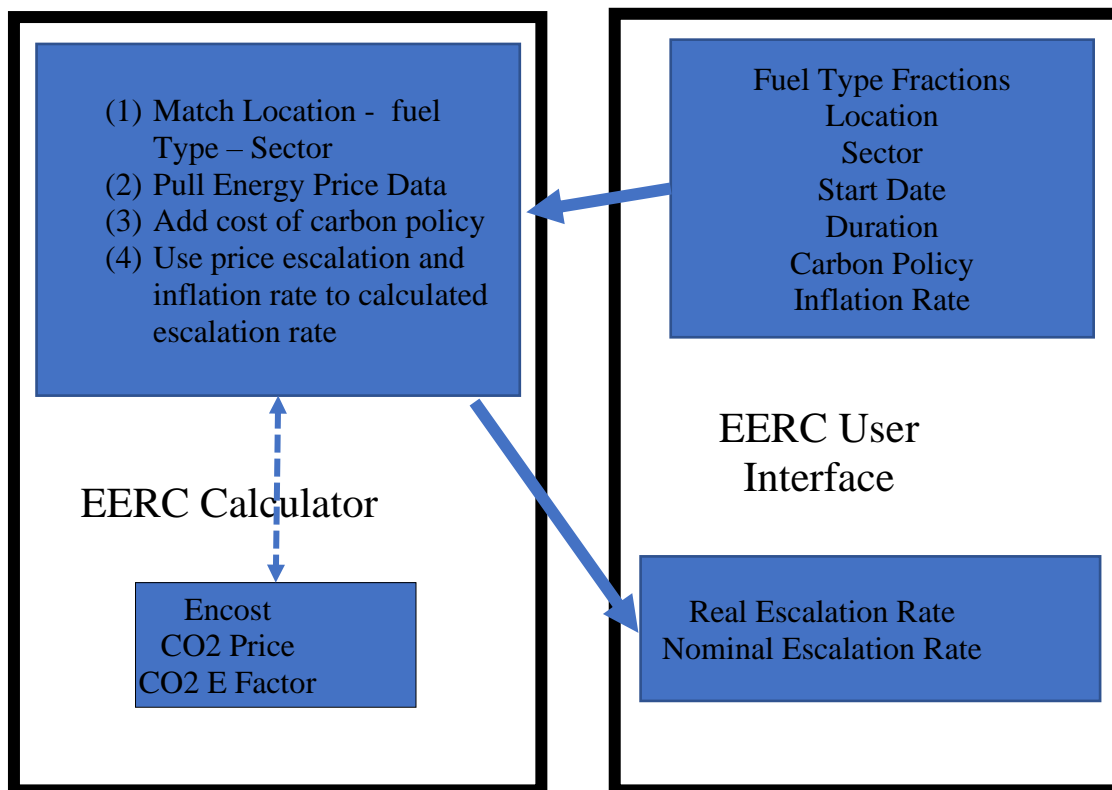
Fuel Rate Information	
Location:	<input type="text"/>
Sector:	<input checked="" type="radio"/> Commercial <input type="radio"/> Industrial

Contract Term	
Start Date:	<input type="text"/>
Duration:	<input type="text"/>

Carbon Pricing Policy	
Policy Option:	No carbon price

Annual Energy Escalation Rate	
Inflation Rate (%):	2.20
Real:	
Nominal:	

This is the flow diagram for the EERC workflow including the required data.



3.1 Inputs and Outputs

EERC prompts the user for information on the share of cost savings attributable to each fuel type, project location, industry sector, and the beginning date and duration of the performance period. It also prompts the user to select one of several carbon pricing scenarios--No Carbon Pricing, Default Pricing, Low Pricing, or High Pricing--then retrieves the relevant energy price forecasts and computes the average escalation rate, as described above. Since the performance period start date could begin later than the base date, the calculated average rate includes the price escalation for the intervening year(s). The calculated average escalation rate is reported in both real (excluding inflation) and nominal (including inflation) terms. The energy price projections for all scenarios exclude inflation and thus generate real rates. The default inflation rate used in the EERC is the long-term inflation rate calculated annually by DOE/FEMP using the method described in 10 CFR 436, but without consideration of the 3.0 % floor for the real discount rate. The default inflation rate does not account for the discount rate floor to accommodate the need for market-based projections of future energy prices in contract negotiations. Otherwise, the default inflation rate would be artificially low in years when the 3.0 % floor applies.

Inputs

Percent of Energy Cost Savings:

- Percentage of energy cost savings in dollars that is attributable to one or more of the fuel types used in the project. This input is used to weight the escalation rate.
- Default values are zeros
- Inputted values must sum to 100%

Fuel Rate Information:

- *Location:* Selection of the state in which the project is located allows the program to select the energy price escalation rates for the corresponding Census Region.
- *Sector:* Selection of commercial or industrial sector determines the type of utility rate schedule applied to the energy cost calculation.
- *User must make a selection of both inputs*

Performance Period:

- *Start Date:* Date when energy savings start to accrue, which is usually after project acceptance at the beginning of performance period.
 - *User must select a start date year*
 - *Options are limited to the next 3 years*
- *Duration:* Number of years of the performance period for which the average escalation rate will be calculated.
 - *User must make a selection for the duration*
 - *The duration is limited between 10 years and 25 years*

Carbon Pricing Policy:

Selection of one of the following carbon pricing scenarios:

1. Carbon price of zero
 - Assumes that no carbon policy is enacted
 - Uses annual energy price forecasts of the Energy Information Administration, which do not account for potential carbon pricing
2. Low carbon prices
 - Assumes that developing countries do not restrict electricity emissions
 - Deflates prices because more and cheaper offsets are available for U.S. polluter purchase
 - Assumes that all states decrease electricity emissions at the national average rate for this policy option
3. Default carbon prices
 - Assumes the most recent climate change bill (*American Clean Energy and Security Act of 2009: H.R. 2454*) is enacted as is with no restrictions on offsets or generating capacity installation
 - Assumes that all states decrease electricity emissions at the national average rate for this policy option
4. High carbon prices
 - Assumes significant restrictions on cheap carbon reduction options
 - No new nuclear and biomass power
 - No offsets
 - Requires more expensive carbon reduction options and drives up carbon prices
 - Assumes that all states decrease electricity emissions at the national average rate for this policy option

Annual Inflation Rate:

The default rate of inflation is the long-term inflation rate calculated annually by DOE/FEMP using the method described in 10 CFR 436, but without consideration of the 3.0 % floor for the real discount rate. The default inflation rate does not account for the discount rate floor to accommodate the need for market-based projections of future energy prices in contract negotiations. Otherwise, the default inflation rate would be artificially low in years when the 3.0 % floor applies. The inflation rate may be edited.

- *The tool makes all the calculations using the default inflation rate*
- *If the user decides to change the inflation rate, the calculations should be re-created.*

Output - Annual Energy Escalation Rates:

- *Real and Nominal Escalation Rates:* The output of the program is the calculated average escalation rate, stated both in real terms (excluding the rate of inflation) and in nominal terms (including the rate of inflation).

Functions

To calculate the nominal escalation rate, which includes inflation, the calculator uses the following relationship:

$$r_{nominal} = (1 + r_{real}) * (1 + r_{inflation}) - 1$$

The calculated average annual escalation rate, e_{avg} , when applied to the base-year energy costs or savings of ESPC or UESC projects, results in approximately the same undiscounted total amounts over the performance period as do the EIA-projected, or adjusted EIA-projected, variable rates. If more than one fuel is used in the project, the EERC weights the average escalation rate according to the proportions stated by the user.

To compute an average annual escalation rate, base-year energy costs are escalated from year to year at rates projected by EIA, or at EIA rates adjusted by NIST for carbon pricing, to arrive at the total energy cost over a given performance period. The escalation rates, e , are projected by Census Region, energy type, and industrial sector and vary from year to year. The formula used EERC prompts the user for information on the share of cost savings attributable to each fuel type, project location, industry sector, and the beginning date and duration of the performance period. It also prompts the user to select one of several carbon pricing scenarios--No Carbon Pricing, Default Pricing, Low Pricing, or High Pricing--then retrieves the relevant energy price forecasts and computes the average escalation rate, as described above. Since the performance period begins later than the base date, the calculated average rate includes the price escalation for the intervening year(s).

to calculate total energy costs is:

$$C = (1 + e_1) * A + (1 + e_1) * (1 + e_2) * A + \dots + (1 + e_1) * (1 + e_2) * \dots * (1 + e_n) * A$$

where

C is the undiscounted total of future energy costs over the performance period

A is the base-year annual cost

e_i is the annual escalation rate, which varies from year to year over the performance period

n is the number of years in the performance period

When the escalation rate is the same in each year of the study period, the series can be simplified to a factor applied to the base-year annual cost, A :

$$C = \left[\frac{(1 + e_{avg})^{n+1} - (1 + e_{avg})}{e_{avg}} \right] * A$$

where e_{avg} is the average annual escalation rate

Since a uniform escalation rate is needed to compute the contract payments in ESPC and UESC projects, the EERC uses this equation to approximate C , as calculated with EIA rates or adjusted EIA rates, and iteratively solves for e_{avg} , the average annual escalation rate. The relationship between the factor calculated in the equation and the variable escalation rates in the series can be expressed as follows for a performance period of n years duration:

$$\left[\frac{(1 + e_{avg})^{n+1} - (1 + e_{avg})}{e_{avg}} \right] = (1 + e_1) + (1 + e_1)(1 + e_2) + \dots + (1 + e_1)(1 + e_2) \dots (1 + e_n)$$

The cost of carbon is calculated using the emissions per unit of fuel type, the carbon price projections, and the carbon emissions factor to calculate a price per unit of fuel. Then its added into the projected energy prices before the escalation rate is calculated.

Take the baseline CO₂ emissions rate and create the emissions rate for each year for a given carbon scenario by multiplying it by the emission factor (fraction of baseline emissions rate by year). This value is then multiplied by the carbon price for the carbon scenario by year. This provides the carbon price per unit of electricity.

The CO₂ emissions rates for other fuels (distillate oil, residual oil, nat gas, LPG, and coal). These rates do not change by year. Therefore, the emissions per unit are constant over time.

The energy price is adjusted by the cost of carbon per unit of fuel (i.e., assumes a 100% pass through to the retail price). This is added before the escalation rates are calculated so that the escalation rates are appropriated adjusted for the carbon scenario.

Data Tables

The data tables include

1. the Encost file that includes the EIA energy price projections for each fuel type over time
 - This file is provided by EIA and then NIST manipulates it to create the annual supplement data
2. CO₂ Price file that includes the projected prices for CO₂ emissions
 - Provided by AEO by scenario and year
3. CO₂ Future Emissions file that includes the projected emissions rate factors for electricity generation over time
 - Fraction of Current Year's Emissions Rate
 - Indifferent to initial baseline CO₂ factors
4. CO₂ Factors file that includes the baseline emissions rates for electricity and other fuel types
 - Electricity emission rates are provided by AEO by zip code
 - This is a change from the old version of EERC, which is by state
 - ZIP Code is matched to balancing authority emissions rates
 - Other fuel types are assumed to be constant using a national average rate

These data tables are called on by the code, will stay constant over time in term of format, but the data is updated annually.